PHYSIOLOGICAL RESPONSIVITY TO VENIPUNCTURE AND SPEECH GIVING IN INSULIN-DEPENDENT DIABETIC ADOLESCENTS AT TWO LEVELS OF DIABETES CONTROL AND THEIR NONDIABETIC PEERS

BY

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This is dedicated to my husband, David Gilbert,

and our two beautiful daughters,

Aline Marie, aged 11, and Elizabeth Ann, aged 3.

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Major Department: Clinical Psychology

Fifteen adolescents with insulin-dependent diabetes in good diabetes control were yoked with 15 insulin-dependent adolescents in poor control matched for age, sex, duration of diabetes, and race. The same number of nondiabetic adolescents matched for age and sex were included. Participants were involved in three stressful tasks (venipuncture and two speeches). Each task was preceded by a rest period and followed by a recovery period. Both speeches were preceded by a plan period. Observational, physiological (heart rate, skin conductance, blood and urine measures), and self-report data were collected. Life stress and personality information were collected. Diabetic adolescents in poor control had higher heart rates

across all conditions but no differences in skin conductance were found. Diabetic adolescents had less desirable blood and urine outcomes compared to the nondiabetic youth with the adolescents with poor diabetes control having the least desirable outcomes. No differences in life stress between groups were found. Adolescents with well-controlled diabetes were less neurotic than the nondiabetic adolescents.

CHAPTER I
INTRODUCTION

A substantial number of people with insulin-dependent diabetes have difficulty adequately controlling this disease. They feel sick, miss school or work and have serious problems carrying out normal activities. One very serious, even life threatening, consequence of poor control is ketoacidosis (Cahil, Etzwiler & Freinkel, 1976). Repeated episodes of ketoacidosis are associated with retinopathy and kidney failure. The increased incidence of poor control and ketoacidosis in 12-18 year olds is well-documented (Fallstrom, 1974; Koski & Kumento, 1975). The relationship between the psychosocial and physiological changes of adolescence and poor control in youngsters with insulin-dependent diabetes is not entirely clear. The question of what contributes to the onset and maintenance of poor control and associated ketoacidotic symptoms in some adolescents while others remain healthy is important in our efforts to successfully manage this chronic illness.

Stress has been frequently implicated in cases of poor diabetic control. Patients with insulin-dependent diabetes may be particularly susceptible to stressful events because they lack insulin, a hormone that counters other "stress"

hormones. More specifically, in both diabetic and nondiabetic persons, stress results in increased levels of catecholamines (epinephrine and norepinephrine). When catecholamines are released into the blood a complex series of events occurs. First, gluconeogenesis is stimulated which increases blood glucose. Second, catecholamines act directly on fat cells to increase lipolysis (fat breakdown and mobilization of free fatty acids (FFA)). Catecholamines also result in increased glucagon, which, in turn, stimulates gluconeogenesis and ketogenesis in the liver (Tarnow & Silverman, 1981-82).

Once the stress is over, there is typically an increase in insulin production which "counters" the stress hormones and permits the body to return to a normal metabolic state. However, the youngster with diabetes does not produce his own insulin and may not be able to counter the effects of the stress hormones. Although exogenous insulin replacement is helpful, the youngster is still left with a system insensitive to rapidly changing stress related blood glucose or ketone levels. When this system is unable to effectively counteract the stress hormones, ketoacidosis may result. Ketones (ß-hydroxybutyric acid and acetone) are produced in the liver from fatty acids (fatty acids -> acetyl-Co A -> acetoacetyl-Co A -> ß-hydroxybutyric acid and acetone). Ketones provide a source of energy, but in excessive amounts produce a low plasma

pH, acidosis. This results in rapid deep breathing, hypotension, and ultimately coma. Ketoacidosis is also associated with hyperglycemia, osmotic diuresis, with electrolyte and fluid loss, vomiting and dehydration. Sodium is markedly depleted in circulation along with a lowered total body potassium (Ganong, 1971).

The role of epinephrine and norepinephrine in stimulating free fatty acid production is supported by the work of Baker, Barcai, Kay, and Hague (1969) and Pinter, Peterfy, Cleghorn, and Pattee (1967). Pinter et al. (1967) demonstrated that FFA levels may be increased by both exposure to stress (i.e., an anxiety-provoking suggestion to hypnotized subjects and spontaneous speeches produced by subjects) and exogenous epinephrine administration. Using a single case design, Baker et al. (1969) found increased FFAs during a stressful interview compared to a nonstress period in an adolescent with insulin-dependent diabetes. The above two studies by Pinter et al. and Baker et al. report that the administration of propranolol (a β-adrenergic blocking agent) in the stressful situtation blocked the bulk of the increase in FFAs. However, Baker et al. noted that the therapeutic effects of adrenergic blocking agents with poorly controlled insulin-dependent diabetic adolescents appear to be short lived. Although this treatment was helpful for a temporary period of time,

eventually the problems with diabetic control returned (Minuchin, Rosman & Baker, 1978).

Only a few studies have compared the effects of stress in diabetic and nondiabetic subjects. Hinkle and Wolf (1952) assessed nondiabetic and diabetic adult and adolescent responses to a stressful interview and a nonstressful control period. Both groups showed similar responses in blood ketone production and urine output. However, diabetics with elevated ketone levels in the nonstressful control period exhibited a particularly exaggerated increase in ketones when stressed. Vandenbergh, Sussman, and Titus (1966) performed a similar study comparing diabetic and nondiabetic adults' reactions to an unpredictable shock. Both groups responded with increases in FFA levels and urine volume, although the increases were not significantly different between stress and nonstress periods. However, this lack of difference may have been a result of their small sample size (i.e., $n = 6$ in each group).

The work of Hinkle and Wolf (1952) and Vandenburgh et al. (1966) suggest that increased free fatty acid production is a likely result of stress. However, a number of questions remain. First, it is unclear whether the responses of insulin-dependent patients are different from subjects having adult-onset diabetes. Most of the subjects studied were adults, not adolescents, and the effects of

diabetes type were not analyzed. Second, although there was some suggestion that patients in poor control may be more stress sensitive, this was not explicitly studied. Consequently, it is unclear whether adolescents with insulin-dependent diabetes differ from normals in their metabolic response to stressful stimuli and whether adolescents in good versus poor diabetic control differ as well. Finally, no objective or subjective measure of stress was collected in either study. Since an external stressor may have different effects on different subjects, it is difficult to assess how many subjects felt stressed and to what extent.

Within the diabetes literature, there is repeated mention of youngsters who have "brittle" diabetes. These patients' (who are often adolescents) diabetes is very difficult to manage, and they have numerous episodes of ketosis. Minuchin et al. (1978) have suggested that there is a subgroup of youngsters who have "psychosomatic" insulin-dependent diabetes. These youngsters show excessive reactivity to stress which results in a "brittle" condition. Support for this position is found in a study by Minuchin et al. (1978) in which psychosomatic insulin-dependent diabetic adolescents were compared to two groups of good control insulin-dependent diabetic adolescents (one composed of normal adolescents and the other of adolescents referred for psychiatric treatment of behavioral

problems). Each group observed their parents discussing unresolved family problems and later joined their parents in this discussion. A major finding in this research endeavor was that in the psychosomatic group the adolescents with diabetes produced higher levels of FFA which took longer to return to baseline when compared to youngsters in the other groups. The psychosomatic adolescents also produced higher FFA levels than their parents which remained elevated after their parents' FFA levels had returned to the baseline level (Minuchin et al., 1978). No similar difference was found for the normal or behavior problem diabetic groups.

The findings of Minuchin et al. (1978) support the notion that a subgroup of insulin-dependent diabetic youth have exaggerated response patterns to stress. Their findings suggest that there are no major metabolic response differences between well-controlled insulin-dependent diabetic youngsters and their parents. However, only a small number of patients were studied and the criteria for placement in study groups (psychosomatic, normal, behavior problem) was not clearly specified. Consequently, it is unclear how many youngsters in poor diabetic control have the "psychosomatic" or heightened stress reactivity that Minuchin et al. postulate.

To summarize the main points made thus far, stress exposure leads to metabolic changes associated with insulin

efficiency in both nondiabetic and diabetic persons. These metabolic changes are related to sympathetic increases of epinephrine and norepinephrine production although other body hormones and transmitter substances are involved. The normal person has finely-tuned metabolic processes which act to keep their metabolic responses within normal limits. However, due to the insulin-dependent diabetic individual's inefficient insulin response capability, more extreme metabolic responses may become more likely. Evidence to date suggests that at least some subgroups of diabetics may be more metabolically reactive than other groups, although the relationship between metabolic responsivity and control level has not been clearly specified. There is less evidence to suggest clear-cut response differences between diabetics as a group and nondiabetics, although this hypothesis has received little research attention.

Major Hypotheses

The primary purpose of the present investigation was to study the effects of stress on youngsters with insulin-dependent diabetes. The stress responses of youngsters with well-controlled diabetes were compared to youngsters in poor control and both diabetic groups were compared to nondiabetic adolescents. Self-report, behavioral, psychophysiological, and metabolic effects of stress were assessed. Few differences on any of the measures were

expected between the well-controlled diabetic youngsters and their nondiabetic counterparts. In contrast, those youngsters in poor control were expected to show greater psychophysiological and metabolic reactivity to stress than either of the two other groups.

The study's hypotheses were as follows:

1. Compared to well controlled diabetics or nondiabetics, insulin-dependent diabetic adolescents in poor control who are stressed in a laboratory setting will exhibit (a) heightened metabolic reactivity, (b) heightened psychophysiological reactivity, and (c) slower rates of psychophysiological recovery subsequent to the stressful experience.
2. Well controlled diabetics will show increased metabolic effects to stress compared to nondiabetic normals.
3. Few differences between groups are expected on the self and behavioral measures of stress and anxiety. However, should differences exist they should be between the poorly controlled diabetic youngsters and the other two groups. If youngsters in poor diabetic control are more stress-reactive, they may acknowledge greater stress and appear more anxious to an observer.

The present investigation differs from past attempts to study the effects of stress on persons with diabetes in a number of important respects. First, only insulin-dependent adolescents were studied. Second, distinctions between those in good versus poor control were made. Third, in both groups of youngsters with diabetes the youngster and parent confirmed that the prescribed insulin dose was given the night before and morning of the experiment. Fourth, self-report, behavioral, and psychophysiological effects of the stress were measured. In past research efforts, no attempt has been made to quantify the stress experienced by the subject either through subjective ratings or by more objective behavioral or psychophysiological measurement. And finally, a sample size of fifteen subjects per group was obtained.

Exploratory Investigations

In addition to the major purposes and hypotheses outlined previously, this study explored two other variables potentially related to diabetes control. These are life stress and the personality dimensions of extraversion and neuroticism.

Life Stress

Evidence has accumulated suggesting that diabetic adolescents with high scores on a life stress/change scale or who have lost a parent show increased ketoacidosis and related symptoms (Chase & Jackson, 1981; Koski & Kumento,

1975). Bradley (1979) found that the number of stressful life events was associated with diabetes control in adults. Furthermore, the insulin treated group had higher levels of diabetes disturbance (glycosuria, prescription changes, and clinic visits) compared to the tablet treated group, although there was little difference between reported levels of life stress in the two groups.

These findings support the hypothesis that life stress is associated with diabetes control particularly in insulin-dependent diabetics.

Introversion-Neuroticism

Hans Eysenck (1967) has postulated two basic dimensions of personality (introversion-extraversion and stability-neuroticism) based on biological inheritance and its interaction with environmental learning (Eysenck, 1967). His neuroticism dimension measures emotional responsivity and reactivity and he suggests that this dimension may be involved in psychosomatic disorders (Eysenck, 1967). Persons high on neuroticism have low tolerance for stress, whether physical or psychological, tend to avoid stressful stimuli, and are "overly emotional, reacting too strongly to all sorts of stimuli, and find it difficult to get back on an even keel after each emotionally arousing experience" (Eysenck & Eysenck, 1975, p. 5). Furthermore, Eysenck (1967) suggests that whereas introversion-extraversion is associated with cortical

functioning/arousal, neuroticism is associated with autonomic arousal which is mediated by the limbic-hypothalamic brain area (Eysenck, 1967).

Eysenck's personality theory and related research suggest that introversion also may be associated with psychosomatic proneness. The unstable introvert, due to his introverted propensities, is more aware of subtle stimuli earlier and the stimuli are more "amplified" in the sense that the introvert is more cortically aroused by it. One may think of the introvert as "geared to inspect" stimuli. This earlier greater awareness of a threatening stimulus should increase autonomic responsivity. Furthermore, Gray (1975) has modified Eysenck's model of extraversion-introversion by suggesting that introverts are more sensitive to particular aversive stimulation, i.e., punishment and frustrative-nonreward and thus more conditionable to situations involving punishment or frustration-nonreward. Both Eysenck and Gray agree that trait anxiety as measured by the Taylor Manifest Anxiety Scale and the Spielberger Trait Anxiety Scale are correlated with Eysenck's neuroticism and introversion scales. In fact, Gray (1975) suggests that a 45 degree rotation of Eysenck's factors would provide more relevant dimensions although not independent factors. The new factors could be labeled trait anxiety and impulsivity. Regardless of the theoretical differences between these

men, both agree introversion should predispose an individual toward increased emotional responding; Eysenck via increased cortical arousal leading to earlier awareness of more subtle threatening cues, and Gray via a biologically increased sensitivity to aversive and frustrative-nonreward cues. Gray's issue is not with the validity of Eysenck's scales, but with the choice of factor rotation and the nature of the underlying biological predisposition.

In summary, high introversion and neuroticism may predispose insulin-dependent diabetics toward higher autonomic arousal and slower return to baseline. This autonomic over-reactivity may predispose them toward more diabetic control problems. It is interesting to note that the two personality descriptions (from parental ratings) that Simonds (1977) found to differentiate well controlled from poorly controlled diabetic youth were anxious and depressed. These are the same personality trait terms that Eysenck (1967) uses to describe an introverted neurotic or dysthymic personality. Due to the strong association between sympathetic reactivity and neuroticism hypothesized by Eysenck, it is reasonable to expect that if this relationship exists it would show up in a diabetic population where sympathetic influences may be magnified by an easily disrupted metabolic system.

Although Eysenck's personality theory has not been applied to problems of diabetic control in insulin-dependent youth, there is extensive literature assessing psychophysiological reactivity in introverts and neurotics compared to other control groups. For example, Stelmack (1981) concluded that differences in electrodermal activity between introverts and extroverts has support with electrodermal activity generally greater for introverts and electrodermal habituation faster for extroverts. In a sample of college women, Harvey and Hirshmann (1980) found significant heart rate differences for introverted-neurotic and extraverted-stable groups who viewed slides of violent death. The introverted-neurotic groups exhibited heart rate increase whereas their counterparts showed heart rate deceleration.

Some additional evidence exists suggesting a relationship between neuroticism and reported illness. Denny and Frisch (1981) found neuroticism to be a predictor of self-reported illness in two samples of college students. Akerstedt and Theorell (1976) found increased physical complaints from neurotic vs. stable railway workers (utilizing Eysenck's personality scale) who were switched from day to night shifts. (Eysenck's scale was administered prior to the shift change.) Less direct evidence for a relationship between neuroticism and illness comes from a study by Mehrabian and Ross (1977). These

authors utilized a stimulus screening questionnaire (high stimulus screening theoretically was related to low arousability) devised by Mehrabian and Ross (1977), which correlated negatively ($r = -.54$) with Eysenck's measure of neuroticism. The high arousability group reported more psychosomatic health complaints and nonrecurring illness.

In summary, the following exploratory hypotheses were tested:

1. Adolescents in poor diabetic control will have higher self-reported levels of life stress than diabetic adolescents in good control or normal nondiabetic youth.
2. Adolescents in poor diabetic control will have higher scores on Eysenck's Neuroticism and Introversion Scales than diabetic youngsters in good control or nondiabetic normals.
3. Subjects scoring high on Eysenck's Neuroticism and Introversion Scales will show heightened psychophysiological reactivity to the laboratory stresses and slower habituation than subjects scoring low on these scales.

CHAPTER 2
METHODOLOGY

Participants

Participants consisted of adolescents with insulin-dependent diabetes and nondiabetic adolescents aged 11-18. Diabetic participants were obtained from lists of patients treated through the North Florida Regional Diabetes Program located at the J. Hillis Miller Health Center, Gainesville, Florida; the University of South Florida Diabetes Program located in Tampa, Florida; and lists of campers attending a summer camp for diabetic youngsters run by these two programs. The nondiabetic youth were recruited from aged 12-18 students at the P.K. Yonge School associated with the University of Florida and through staff at the J. Hillis Miller Health Center.

Subjects were contacted based on their hemoglobin A1 (HA1) values, a physiological measure used to assess diabetes control over several weeks time (Tarnow and Silverman, 1981-82). The HA1 is a measure of the amount of glucose adhering to hemoglobin in the blood and reflects amount of blood glucose over a period of time. In this study, adolescents in good diabetic control had HA1 values

of 12 or less and those in poor control had values 15 or over. These cutoff scores are based on Harkavy's (1981) study in which similar scores discriminated good and poor control as defined by diabetologists' ratings. The HA1 value obtained at the time of the study served as the final criterion and in three cases a participant whose HA1 was slightly above 12 was kept as a good control subject if his/her match had a value above 16.

All adolescents having diabetes at least one year and meeting the HA1 criteria for good control were asked to participate if a potential poor control match could be identified. Participants were matched on sex, age, race, and duration of diabetes. Matched subjects had to be of the same sex, within 2 years of age, and of the same ethnic group (except in one case where a white male was substituted for a black male). Poor control subjects could not have had diabetes more than 1 year longer than their counterparts.

Each potential subject and his/her parent indicated that the recommended insulin dose was regularly administered and specifically acknowledged that the required dose was administered at the regular time the night before and the morning of the experimental session. If the subject or parent indicated that this was not the case, the adolescent was not used as a subject. This occurred with two potential poor control subjects.

The nondiabetic group was obtained by advertising at the P.K. Yonge School and through staff at the J. Hillis Miller Health Center. They were of the same sex, race, and within 2 years in age of both their diabetic matches. All study participants were paid money; $15 the first year data were collected and $25 the second year.

Stress Manipulation Task

Each youngster participated in three potentially stressful tasks. First a heparin lock was inserted in the participant's arm or hand for the initial blood withdrawal. The needle insertion was preceded by a 3 minute rest period and followed by a 3 minute recovery period. Secondly, each participant was asked to give two 3 minute speeches. Each speech was preceded by a 3 minute rest period and planning period. Both speeches were followed by a 3 minute recovery period. Participants remained seated for both blood withdrawal and speech giving. All three events were videotaped. Each rest and recovery period was preceded with the request to close their eyes and rest and relax as completely as possible "as if they were going to sleep."

Speeches

Each subject was asked to give two speeches. She was told that she would have 3 minutes to plan the speech and a clock was pointed out to time the planning. No pencils or

paper was available for notetaking in the plan period. The topics were "the last big argument I had or my most recent big disappointment" and "a recent fun or pleasant time I had or something very nice that happened to me." See Appendix A for the instructions that accompanied each topic. Each subject was told that the speech would be videotaped and a small audience would listen. At least one male and female were present during speech giving. Matched subjects were yoked to the same speech order and the order of the two speeches was alternated between sets of matched subjects. If a subject "froze" in his speech, one of the audience would say a phrase designed to keep the talk going. Examples included "tell us some more about that," "keep going," "what else." Generally the audience was supportive and friendly and listened to the subject with an interested affect.

Major Dependent Measures

Heart Rate

One sympathetic response to emotional stress is increased heart rate. Increased heart rate has been used as an indicant of emotional arousal and remains sensitive across several consecutive stressors punctuated by brief rest periods (Harvey & Hirschmann, 1980; Shipman, Heath & Oken, 1979).

Whether or not heart rate accelerates or decelerates is greatly dependent on the nature of the task or

stimulus. Siddle and Turpin (1980) point out that heart rate decelerates in response to simple stimuli and accelerates to intense or threatening stimuli, during periods of word association tasks, and during mental arithmetic tasks. Heart rate increases in both the anticipatory and performance phases of public speaking (Borkovec & O'Brien, 1977; Knight & Borden, 1979; Levenson, Jaffee & McFall, 1978). Please refer to Appendix B for a brief discussion of the heart and primary theories regarding its regulation.

Heart rate data were collected on a Lafayette four-channel datagraph. Paper speed was 10 mm/sec. Heart rate was obtained by counting the systolic spikes associated with the cardiac contraction of the recorded pulses of the photoplethysmographic transducer. The photoplethysmographic transducer was attached to the thumb of the left hand unless this arm held the heparin lock, in which case it was attached to the thumb of the right hand.

Heart rate in beats per minute (bpm) was tabulated for each 1-minute segment of each period. Each period except blood withdrawal (rest, plan, speech, recovery) lasted 3 minutes. Blood withdrawal lasted 2 minutes. The mean heart rate of each period served as the respective period score (rest, blood withdrawal, recovery, plan, and speech).

Skin Conductance

Measurement of the conductance of an electrical current through skin tissue is often used as a physiological indicant of arousal (Martin & Venables, 1980). Due to the high density of eccrine sweat glands (which are innervated by the sympathetic nervous system) on palmar and plantar skin surfaces, these sites are typically used to obtain electrodermal information. Between group differences in skin conductance activity on stress-inducing tasks have been found (Knight & Borden, 1979; Levenson, Jaffee & McFall, 1978). Please see Appendix C for a brief note on skin conductance.

Skin conductance data were collected on a Lafayette four-channel datagraph with paper speed of 10 mm/sec. Skin conductance level and responses were recorded via bipolar leads from the middle phalanges of the first and second fingers of the left hand (unless this arm held the heparin lock in which case the right hand was used) using Beckman silver/silver chloride miniature electrodes with K-Y Lubricating Jelly (Johnson & Johnson) as an electrode medium.

Skin conductance was measured in micromhos. Skin conductance levels were measured at each 20 second point for each 1-minute segment during the 3-minute rest period, the 3-minute plan period, the 3-minute task period (or 2-minute blood withdrawal), and the recovery period. For

each period the mean of the skin conductance levels was calculated and served as the score for each period. The number of spontaneous conductance fluctuations equaling or exceeding 0.1 micromhos was counted for each 3-minute phase.

Blood Measures (FFA and Glucose)

Free fatty acids (FFA) and blood glucose increase in response to stressful stimuli and are related to metabolic disruption in diabetes (Tarnow & Silverman, 1981-82). These blood measures were analyzed from blood samples drawn at the beginning and end of the experimental session.

Urine Measures (Ketones, Glucose, and Volume)

Ketones increase in response to stress (Tarnow & Silverman, 1981-82) and urine volume and urine sugar have been shown to increase in response to stress exposure (Hinkle & Wolf, 1952; Vandenbergh et al., 1966). These urine measures were analyzed from urine samples taken at the beginning and end of the experimental session-task manipulations.

Venipuncture Questionnaire (VQ)

The VQ is a two-item Likert scale developed by the researcher to allow the participant to rate venipuncture (see Appendix D). The participant rated the task on two 5-point scales asking how bothered by and painful the venipuncture procedure was for them.

State Trait Inventory for Children (STAIC)

The state portion of the STAIC was administered to all adolescents after each of the three tasks. The STAIC is designed to measure both transitory anxiety specific to stressful events (state anxiety) and stable anxiety with consistency and permanence across time and events (trait anxiety). Only the 20-item state anxiety portion of the instrument was used in this study. The state portion of the STAIC has good split-half reliability, r = .89 (Finch, Montgomery & Deardorff, 1974), and has shown changes as a function of stress (Bedell & Roitzch, 1976; Finch, Kendall, Montgomery & Morris, 1975). The STAIC has been used predominantly with children aged 8 and over. The STAIC was orally administered and the subject responded to the task portion of the procedure (blood withdrawal, speech).

Venipuncture Observation Scale (VOS)

The VOS was developed by the researcher to assess observed anxiety in the venipuncture situation. Appropriate items were selected from the Self-Injection Behavior Profile Rating Scale (previously developed by the researcher and S. Johnson, 1982). Other items were developed from observed signs of nervousness noted by medical staff involved in venipuncture. Ratings were obtained from videotaped venipuncture session and interrater reliabilities were obtained. Presence or absence of each item was assessed for each 20 second

interval. Please see Appendices E and F for the VOS and scoring procedure.

Rank Order of Task Form (ROTF)

The ROTF is a form developed by the researcher to allow the participant to rank order the tasks from most stressful to least stressful (Appendix G).

Personal Report of Confidence as Speaker Short Form (PRCS)

The PRCS is a 30-item questionnaire revised by Paul (1966) from an earlier and longer version in order to improve the form's psychometric properties and make its completion easier and quicker for the informant. The instrument is designed to assess self-reported public speaking anxiety.

Time Behavioral Checklist for Performance Anxiety (TBCL) Modified Form

The TBCL was developed by Paul (1966) to assess performance anxiety exhibited during a public speaking exercise. The instrument lists 20 observable manifestations of anxiety and is scored for their presence or absence during consecutive 20-second observation periods. The TBCL assesses behaviors reflecting interference with performance (e.g., stammering) and observable effects of arousal on behavior (e.g., heavy breathing). The TBCL was modified by deleting items that were inappropriate for videotaped speeches by seated persons (e.g., pacing). Several items were added from

other facial rating protocols by Ekman and Friesen (1975) including miserable smile and facial emblem negative. Paul (1966) reports the average interobserver reliability after training exceeded $\underline{r}$ = .95. Other investigators using the TBCL have reported interrater reliabilities after training between .71 to .96 (Ciminero, Calhoun & Adams, 1977). Ratings were obtained from videotaped performances and interrater reliabilities computed. Raters were trained prior to scoring. See Appendices F and H for TBCL-M form and scoring procedures.

Additional Dependent Measures

Junior Eysenck Personality Questionnaire (JEPQ)

The JEPQ is a personality inventory designed to measure extraversion, neuroticism, psychoticism, and conventionality for children aged 7-15 (Eysenck & Eysenck, 1978). Only the neuroticism, extraversion, and conventionality scales were used. Six month test-retest reliabilities for each scale by age and sex are as follows: extraversion range--.38-.82, with all remaining coefficients in the .60's and .70's; neuroticism range--.66 to .77, the conventionality scale range--.59 to .83; with all remaining coefficients in the .60's and .70's. One month test-retest reliabilities were considerably higher with a range across scales by age and sex of .59 to .89, with most coefficients in the .70's and .80's.

The JEPQ is an extension for children of the EPQ with normative and reliability data available, but lacking extensive validational studies. A manual to help interpret scores is available.

Eysenck Personality Questionnaire (EPQ)

The EPQ is a personality inventory designed to measure the same personality factors as the JEPQ in adults aged 16 and older. The extraversion, neuroticism, and conventionality scales of the EPQ were administered to the 16-18 year-old subjects. One month test-retest reliabilities by group and scale are primarily in the .80's, with a range of .72 to .92; overall reliability coefficients were as follows: extraversion was .90 and .86; neuroticism was .89 and .80; and conventionality was .86 and .86, for men and women, respectively. The extraversion and neuroticism scale were produced through factor analytic procedures and are orthogonal factors. Eysenck and Eysenck (1975) report that others have reproduced this factor pattern and they report validity data using twin and other experimental studies (Eysenck & Eysenck, 1975). A manual to help interpret scores is available.

Life Events Checklist (LEC)

The LEC is a 46-item (plus four blank spaces for individual responses) inventory of significant life events for adolescents (Johnson & McCutcheon, 1980). The

respondent is requested to check those events (s)he experienced during the preceding year, rate the event as good or bad, and rate the degree of impact the event on his/her life on a 4-point scale from no effect = 0 to great effect = 3. This instrument developed by Gad and Johnson (1980) is relatively new and was developed to overcome specific deficiencies in the existing life change/stress inventories. Specific items were selected from existing life change/stress inventories and nominations by an adolescent sample. It has been administered to adolescents aged 12 to 17 and found to correlate with indices of physical and emotional health.

Procedure

The families were asked to participate either by telephone or in a letter. A letter was used only when there was no telephone in the home. If both parents and adolescent agreed to participate, an appointment time was scheduled. Parents were asked to observe the insulin injection of their child the night before and morning of the experiment. In all cases, an informed consent was obtained from both the adolescent and parent. The parent was given an LEC form to complete while the youngster was taken to the study area.

First the participant voided urine into a container. Then she was taken to the room where the experiment was to transpire and the equipment was explained. Words like

electrodes were avoided and attempts were made to use nonthreatening and understandable words to explain the different pieces of equipment (videorecorder and camera, physiograph, leads). Although visible, the tray with venipuncture equipment was placed somewhat behind the youngster. The adolescent was seated in a comfortable chair and the heart rate and skin conductance electrodes were attached to the hand. Then the participant was asked to close his/her eyes and rest for 3 minutes. Afterward the videorecorder was turned on and the heparin lock inserted. When the venipuncture procedure was completed, the recorder was turned off and the adolescent asked to rest with closed eyes for 3 minutes. After the recovery period, the following questionnaires were administered (by the researcher reading the items outloud): STAIC (applied to blood withdrawal), VQ, JEPQ or EPQ, LEC, and PRCS. After completion of the questionnaires which took about 30 minutes, the 3-minute baseline rest for the first speech took place, followed by presenting the topic to the subject and giving him/her 3 minutes to plan the speech. Then the audience came in the room, the videorecorder was turned on, and the adolescent gave the speech. This was followed by the 3-minute recovery period. The STAIC (for the speech) was administered a second time. Then the same procedure was followed for the second speech. After the recovery period for the second speech, the STAIC (for the second

speech) was readministered and the final blood withdrawal done and heparin lock discontinued. The ROTF was administered, the electrodes were removed from the youngster's hand, and the Peabody Picture Vocabulary Test was given. The participant was debriefed and paid.

CHAPTER 3
RESULTS

Description of Sample

Forty-five adolescents participated including 18 females, 27 males, 8 black and 37 nonblack subjects. Each good control diabetic subject (GCDS) was yoked to a same sex, same race subject with the exception of one black GCDS whose poor control diabetic subject (PCDS) match was nonblack.

An ANOVA was performed for age and no significant difference between groups was found ($F(2,42) = .616$, $p = .54$). Mean ages by group were GCDS--14.75 years, PCDS--13.92 years, and nondiabetic subjects (NDS)--14.33 years. The range of age was 11 to 18.8 years.

Duration of Diabetes and HA1 Values

A t-test was computed to determine differences between GCDS and PCDS in duration of diabetes. No significant differences were found ($t(28) = .82$, $p = .421$). The mean number of years for duration of diabetes for the GCDS was 5.62 and for the PCDS 4.47.

A t-test showed significant difference for HA1 values between the GCDS and PCDS ($T = -9.77$, $p < .001$). The mean

value for the GCDS was equal to 11.26 with a range of 8.5 to 13. The mean value for the PCDS was equal to 16.23 with a range of 15 to 18.5.

Time of Day and Location of Data Collection

A 3 X 3 chi-square statistic was computed and no evidence emerged suggesting differences between groups in time of day subjects were run (chi-square = 3.6, $p = .50$).

An equivalent number of GCDS and PCDS were run in Gainesville and in clinics outside Gainesville. Eight GCDS and eight PCDS were run in Gainesville and the remaining seven in each group outside Gainesville. All NDS were run in Gainesville.

Reliability of Observation Measurement

Pearson product moment correlations were computed for interscorer reliability of observed anxiety (VOC, TBCL). The following reliability coefficients were obtained: for the VOC, $r = .79$, $p < .001$; for the first speech (TBCL), $r = .75$, $p < .001$; and for the second speech (TBCL), $r = .71$, $p < .001$. No significant differences were found between scorers with t values and probabilities as follows: VOC ($t = .94$, $p = .36$); first speech TBCL ($t = .66$, $p = .52$); and second speech TBCL ($t = 1.6$, $p = .13$).

Subject-Parent LEC Correlations and T-Tests

Pearson product moment correlations were computed between the subject and parent forms of the LEC. Pearson

product moment correlations were obtained for various possible scoring methods and the following validity coefficients were obtained: total events rated good--*r* = .40, p = .05; total events rated bad--*r* = .54, p = .004; total events rated good and weighted for impact on life--*r* = .48, p = .01; total events rated bad and weighted for impact on life--*r* = .60, p = .001, sum of total number of events--*r* = .35, p = .08; and sum of total number of events weighted for impact on life--*r* = .50, p = .009. Paired t-tests were computed between the subjects' and parents' LEC scores. There was a significant difference between all scores from the various possible methods; youngsters, compared to the parents, reporting more events and having higher weighted score.

Inter-relationships Between Measures

Pearson product moment correlations were completed between the physiological, self-report, and observation data. Appendix I is a compilation of a selection of these Pearson coefficients. Physiological variables had coefficients ranging from .04 to .72 (post-blood sugar and urine volume) with the majority between .20 and .40 (HRs with FFA and blood sugars). Self-report measures had coefficients between .02 and .59 (the first STAIC with rated venipuncture fear) with most higher than .25 (STAIC, JEPQ, Speech Fear Questionnaire). Validity coefficients between self-report, physiological, and observation data

ranged from no relationship to .52 (observed video anxiety for venipuncture with rated venipuncture pain).

Control Variables

Speech Fear (PRCS)

No significant differences were found between the three groups on reported speech fear (PRCS) using a oneway ANOVA ($F(2,42) = .51$, $p < .60$). The following mean scores by experimental group were found: GCDS = 11.47, PCDS = 10.67, NDS = 13.20; where the higher the score, the more fear indicated.

Venipuncture Fear (VQ)

An ANOVA was computed between all groups for rated venipuncture fear (VQ) and no statistically significant differences emerged ($F(2,42) = 1.58$, $p < .22$). The following mean ratings by experimental group were found: GCDS = 4.33, PCDS = 3.93, NDS = 3.60; where the lower the score, the more fear indicated.

Venipuncture Pain (VQ)

An ANOVA was computed between all groups for venipuncture pain and no statistically significant difference occurred ($F(2,42) = .16$, $p = .85$). The mean ratings by experimental group were as follows: GCDS = 4.13, PCDS = 4.00, NDS = 3.93; where the lower the score, the more pain indicated.

Venipuncture Observation Scale (VOS)

An ANOVA was computed for observed venipuncture anxiety for all groups and no statistically significant differences were found ($F(2,28) = 1.60$, $p = .22$).

Observed Speech Anxiety (TBCL)

An ANOVA was computed between all groups for observed speech anxiety for both speeches. No statistically significant differences were found for either speech [first speech--($F(2,34) = .327$, $p = .72$), second speech--($F(2,33) = .03$, $p = .97$)].

Reported Anxiety (STAIC) for Venipuncture and Speeches

An ANOVA was computed between all groups for the STAIC for venipuncture and no statistically significant results emerged ($F(2,42) = .44$, $p = .65$). ANOVAs were performed on the STAIC administered for each of the speeches. No significant differences were found for the second speech ($F(2,42) = .28$, $p = .76$) but a tendency toward significance occurred on the first speech ($F(2,42) = 2.96$, $p = .06$). A Duncan's Range Test at the .05 level of significance showed the PCDS reported more anxiety than the GCDS. Means for the three groups are as follows: GCDS = 33.73, PCDS = 40.13, NDC = 35.67.

Rank Order of Task Form (ROTF)

Two 3 X 3 chi-square statistics were computed for the rank order of tasks by subjects. The first chi-square analysis found no difference between groups in rank

ordering venipuncture, first speech, and second speech (chi-square = 3.4, $p < .50$). The second analysis found no difference between groups in rank ordering venipuncture, the speech on a pleasant topic, or the speech on an unpleasant topic (chi-square = 6.0, $p < .20$).

Speech Order and Heart Rate

A 3 X 2 X 4 repeated measures ANOVA was computed for experimental group, speech order and period (rest, plan, speech, recovery) for both speeches. No main or interaction effects were found for speech order in either speech ($F(1,37) = 1.17$, $p = .29$) and ($F(1,39) = .59$, $p = .45$), respectively.

Speech Order and Skin Conductance

A 3 X 2 X 4 repeated measures ANOVA was performed for experimental group, speech order, and period (rest, plan, speech, recovery) for both speeches. No significant differences were found for speech order in either speech ($F(1.38) = 1.76$, $p = .19$) and ($F(1,37) = 2.87$, $p = .10$), respectively.

Analyses of Major Hypotheses

Heart Rate for Venipuncture

A 3 X 2 X 3 repeated measures ANOVA was computed for experimental group, sex, and venipuncture period (rest, blood withdrawal, recovery). Significant main effects were found for experimental group ($F(2,39) = 6.25$, $p = .004$), sex ($F(1,39) = 9.63$, $p = .004$), and period ($F(2,78)$

= 14.26, $p < .001$). A significant period X sex interaction occurred ($F(2,78) = 3.40$, $p = .04$). Subsequent ANOVAs for experimental group accompanied by Duncan's Multiple Range Tests (at the .05 level of significance) found the heart rate for PCDS was significantly higher than the two remaining groups at each period of the venipuncture procedure [rest ($F(2,42) = 4.17$, $p = .02$); blood withdrawal ($F(2,42) = 6.58$, $p = .003$); recovery ($F(2,42) = 4.37$, $p = .02$)]. Figure 1 illustrates the magnitude of the HR differences.

Overall females had a higher heart rate in beats per minute (BPM) with a mean equal to 90.19 BPM compared to 80.35 BPM for males.

Utilizing paired t-tests it was found that HR during blood withdrawal was significantly higher than HR during the rest or recovery period ($t(44) = -5.14$, $p < .001$) and ($t(44) = 3.76$, $p = .001$), respectively. ANOVAs were computed for sex by period with subsequent Duncan's Multiple Range Tests performed. Whereas males had significantly lower HRs in the rest and blood withdrawal periods of the venipuncture procedure ($F(1,43) = 10.11$, $p = .003$ and $F(1,43) = 8.77$, $p = .005$, respectively), no such sex difference was found in the recovery period ($F(1,43) = 1.43$, $p = .24$).

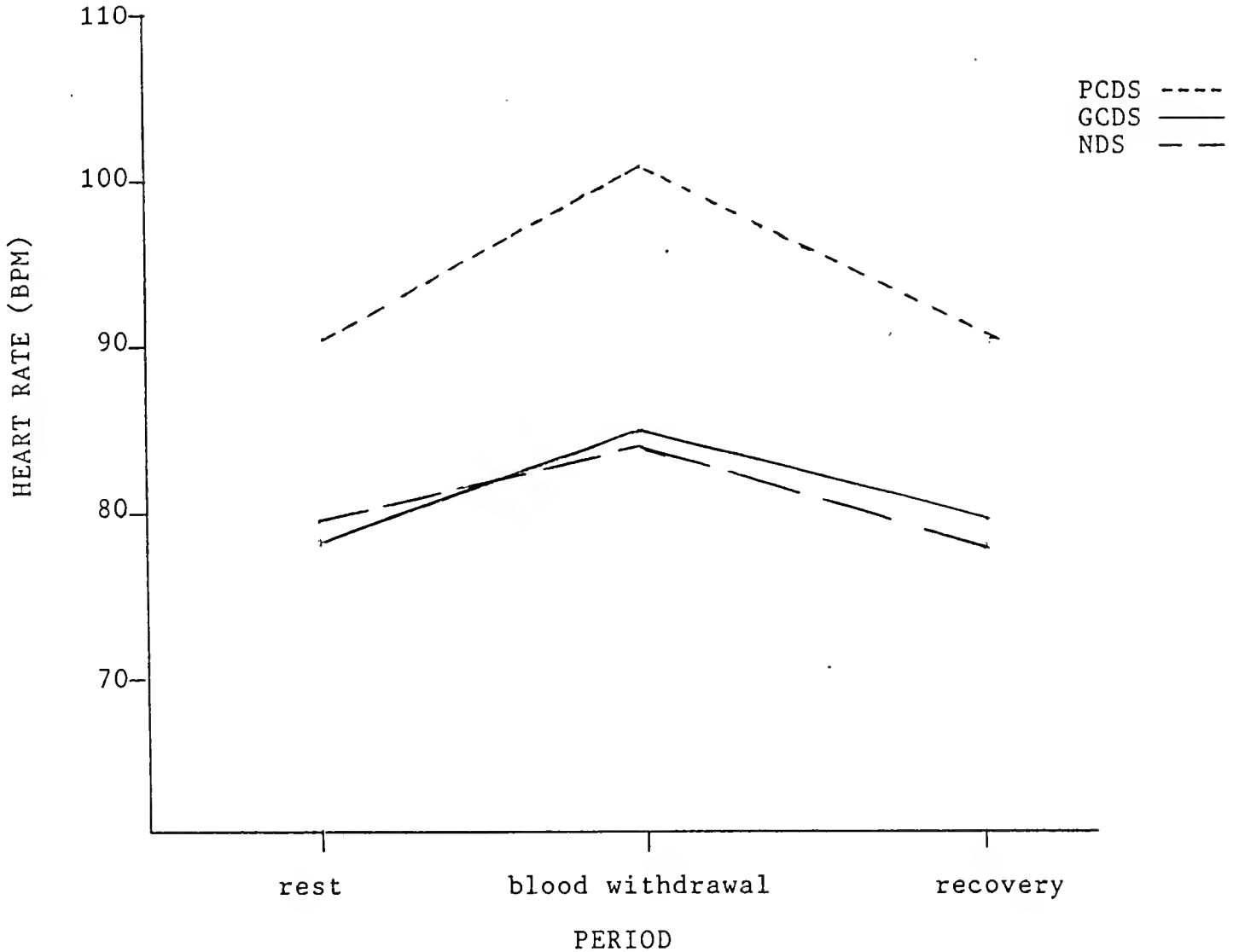

Figure 1. Mean heart rate in beats per minute for venipuncture rest, blood withdrawal and recovery by experimental group.

Heart Rate for First Speech

A 3 X 2 X 4 repeated measures ANOVA was computed between experimental group, sex, and period. Significant main effects were found for experimental group ($F(2,39) = 5.65$, $p = .007$), sex ($F(1,39) = 9.51$, $p = .004$), and period ($F(3,117) = 32.35$, $p = .000$). In each case the PCDS had significantly higher HRs than the NDS and, with the exception of the speech period higher than the GCDS. See Figure 2 for the comparison of HR by experimental group and period.

Overall females had higher HRs with a mean HR of 89.54 BPM compared to an 80.13 mean for males. Paired t-tests were computed between all possible combinations of periods in the first speech and the rest and recovery periods significantly differed (were less) from the plan ($t(44) = -3.17$, $p = .003$ and $t(44) = 40.57$, $p = .000$, respectively), and speech periods ($t(44) = -7.32$, $p = .000$ and $t(44) = 8.39$, $p = .000$). Heart rate during the plan period likewise was less than the speech period ($t(43) = 39.17$, $p < .001$).

Heart Rate for Second Speech

A 3 X 2 X 4 repeated measures ANOVA was computed for experimental group, sex, and period. Significant main effects were found for sex ($F(1,37) = 4.19$, $p = .05$) and period ($F(3,111) = 31.65$, $p < .001$). A tendency for experimental group to be significant was found

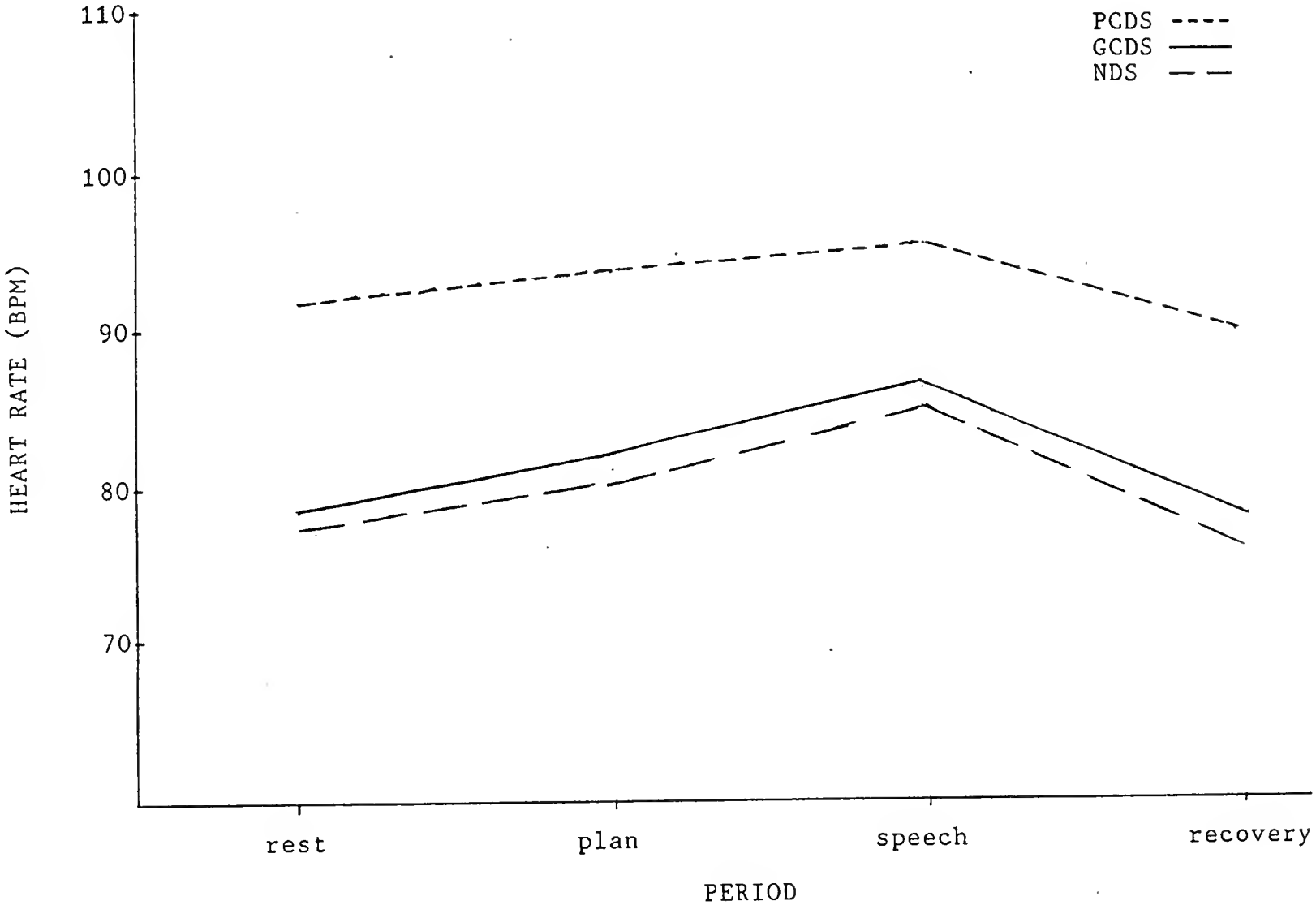

Figure 2. Mean heart rate in beats per minute for first speech rest, plan, speech, and recovery by experimental group.

($F(2,37) = 2.54$, $p < .09$) with PCDS having higher HRs that GCDS and NDS. Female subjects had higher heart rates (86.83 BPM compared to the 80.6 BPM of their male counterparts.

Paired t-tests showed that the rest and recovery periods had lower HRs than the plan ($t(44) = -3.53$, $p = .001$ and $t(42) = 1.87$, $p = .07$) and speech periods ($t(44) = -7.84$, $p < .001$ and $t(42) = 8.89$, $p < .001$). The planning period had a lower HR than the speech period ($t(44) = -8.00$, $p < .001$).

Skin Conductance for Venipuncture

A 3 X 2 X 3 repeated measures ANOVA was computed for experimental group, sex, and period. A significant main effect was found for period ($F(2,78) = 44.76$, $p < .001$). Paired t-tests showed each period significantly different from the others with the highest level of skin conductance in the blood withdrawal period and lowest level in the rest period. The T values were as follows: rest-blood withdrawal ($t(44) = -7.99$, $p < .001$); rest-recovery ($t(44) = -6.28$, $p < .001$); and blood withdrawal-recovery ($t(44) = 3.10$, $p = .003$).

Skin Conductance for First Speech

A 3 X 2 X 4 repeated measures ANOVA for experimental group, sex, and period was computed which found a significant effect for period ($F(3,114) = 17.35$, $p < .001$). Paired t-tests were computed and skin conductance

levels were less in the rest and recovery periods when compared with the plan ($t(43) = -2.77$, $p < .008$) and ($t(43) = 2.4$, $p < .02$) and speech ($t(43) = -5.74$, $p < .001$) and ($t(43) = 5.78$, $p < .001$) periods. The speech period had higher levels of skin conductance when compared with the plan period ($t(43) = -3.16$, $p < .003$).

Skin Conductance for Second Speech

A 3 X 2 X 4 repeated measures ANOVA was computed. A significant main effect was found for period. Subsequent paired t-tests were computed and found speech skin conductance differed significantly (was higher) from all other speech periods with t values as follows: from rest ($t(44) = -3.88$, $p < .001$); from plan ($t(43) = -2.0$, $p < .05$); and from recovery ($t(42) = 4.95$, $p < .001$). Skin conductance in the planning period was higher than in the rest period ($t(43) = -4.29$, $p < .001$).

Skin Conductance Fluctations-Venipuncture

A 3 X 2 X 3 repeated measures ANOVA was computed between experimental group, sex and period. A significant main effect was found for period ($F(2,76) = 26.53$, $p < .001$). Paired t-tests were utilized to compare each period with the other periods. The blood withdrawal period had a higher number of skin conductance fluctuations than the rest or recovery period ($t(44) = -7.02$, $p < .001$ and $t(44) = -1.85$, $p < .07$, respectively).

Skin Conductance Fluctuations for First Speech

A 3 X 2 X 4 repeated measures ANOVA was computed for experimental group, sex, and period. A significant main effect for period ($F(3,114) = 76.89$, $p < .001$) and an interaction between period and experimental group ($F(6,114) = 2.38$, $p < .04$) were found. The rest and recovery periods had fewer SC fluctuations than the plan ($t(43) = -8.4$, $p < .001$ and $t(43) = 7.29$, $p < .001$, respectively) and speech periods ($t(43) = -10.71$, $p < .001$ and $t(43) = 9.91$, $p < .001$, respectively). The plan period had fewer fluctuations than the speech period ($t(43) = -4.72$, $p < .001$). Experimental group was significant only in the speech period ($F(2,41) = 3.08$, $p < .06$) with a subsequent Duncan's Multiple Range Test showing that the GCDS had more fluctuations than the PCDS with the following means: GCDS = 14.53, PCDS = 9.57, and NDS = 10.87.

Skin Conductance Fluctuations for Second Speech

A 3 X 2 X 4 repeated measures ANOVA was computed for experimental group, sex, and period. A significant main effect was found for period ($F(3,111) = 41.64$, $p < .001$). Each period was compared with the remaining three periods utilizing paired t-tests. The rest and recovery periods had the lowest number of fluctuations compared to the plan ($t(43) = -6.59$, $p < .001$ and $t(42) = 6.29$, $p < .001$, respectively) and speech periods ($t(44) = -9.11$, $p < .001$ and $t(42) = 8.41$, $p < .001$, respectively). The speech

period had the highest number of SC fluctuations ($t(43) = -4.44$, $p < .001$).

Life Events Checklist (LEC)

A oneway ANOVA was computed using the LEC completed by the adolescent for each of several methods of scoring the LEC and none reached statistical significance. The F values and probabilities for each scoring method are as follows: total events rated good ($F(2,41) = .43$, $p = .65$); total events rated bad ($F(2,41) = .40$, $p = .68$); total events rated good and weighted by impact on life ($F(2,41) = .08$, $p = .92$); total events rated bad and weighted by impact on life ($F(2,41) = .70$, $p = .50$); sum of total good and bad events ($F(2,41) = .31$, $p = .74$); and sum of total good and bad life events weighted for impact on life ($F(2,41) = .17$, $p = .85$).

Eysenck Personality Questionnaire (EPQ, JEPQ)

A oneway ANOVA was computed for experimental group for each dimension of the EPQ (extraversion, neuroticism, psychoticism, conventionality). All EPQ and JEPQ scores were converted to t scores with mean = 50, SD = 10 (based on age and sex norms in Eysenck & Eysenck, 1975, 1978) before analyses. No significant differences were found for extraversion ($F(2,42) = 1.00$, $p = .38$) or psychoticism ($F(2,42) = .38$, $p = .69$). A significant F value was obtained for neuroticism ($F(2,42) = 5.9$, $p < .005$) and a subsequent Duncan's Multiple Range Test (at the .05 level

of significance) was performed and found the good control diabetic group differed significantly (less neurotic) from the remaining two groups. The mean t score for the GCDS was 45.13 compared to 52.87 and 55.73 for the PCDS and NDS, respectively. An ANOVA was performed for conventionality which showed a tendency ($F(2,42) = 2.48$, $p = .10$) for GCDS to positively endorse conventional items more frequently than the NDS utilizing Duncan's Multiple Range Test. The mean t score for the GCDS was 58.47 compared to 55.20 and 50.80 by the PCDS and NDS, respectively.

A series of Pearson product moment correlations were computed between extraversion and neuroticism and HR and skin conductance for all the individual periods in the venipuncture procedure and the speeches. No significant correlations for HR or skin conductance were found. As a result, no further analyses of extraversion or neuroticism and psychophysiological arousal were done.

Free Fatty Acid (FFA)

A 3 X 2 X 2 repeated measures analysis was computed for experimental group, sex and time of measurement (pre-post blood withdrawal). A tendency toward significance for experimental group was found ($F(2,34) = 2.8$, $p = .07$). A Duncan's Multiple Range Test at the .05 level of significance found that the PCDS differed from the NDS at the first blood withdrawal. Mean values were as follows: GCDS = .44; PCDS = .59; NDS = .31. Although not

statistically significant, the same pattern of mean values was found for the post FFA sample, i.e., GCDS = .49, PCDS = .55, and NDS = .36.

Blood Sugars

A 3 X 2 X 2 repeated measures ANOVA was computed for experimental group, sex and trial (pre- and post-blood withdrawal). A significant main effect for experimental group ($F(2,28) = 14.12$, $p < .001$) and a trial by sex interaction ($F(1,28) = 9.82$, $p < .004$) were found. A oneway ANOVA and subsequent Duncan Multiple Range Test were computed for both pre- and post-blood withdrawals. The overall model was significant for both blood withdrawals ($F(2,35) = 15.38$, $p < .001$ and $F(2,32) = 15.89$, $p < .001$, respectively). At the .05 level of significance the Duncan Multiple Range Test found all three experimental groups differed significantly from each other at the initial withdrawal but only the NDS differed from both diabetic groups at the second withdrawal. Mean blood sugar values for the first and second blood withdrawals, respectively, were as follows: GCDS = 210.73, 215.17; PCDS = 294.5, 275.84; and NDS = 59.8, 65.64. Although at the first blood withdrawal females had significantly higher levels of blood sugar, no significant difference was found at the second blood withdrawal.

Urine Volume

A oneway ANOVA was computed for experimental group with urine volume. Overall significance for the model was found at ($F(2,42) = 5.67$, $p = .007$). A Duncan's Multiple Range Test showed that the NDS differed from the two diabetic groups with a mean volume of 69.67 cc compared to 183.8 for the GCDS and 256.67 for the PCDS.

Pre- and Post-Urine Sugar

A Wilcoxin rank sum test (equivalent to the Mann-Whitney U test) was computed for GCDS and PCDS urine sugar levels for pre- and post-experimental session. No significant differences were found between groups at the beginning of the experimental session ($z = .41$, $p = .66$) but the PCDS had larger values at the end of the session ($z = 1.85$, $p = .04$). All NDS had 0 percent urine sugar.

Pre- and Post-Urine Ketones

A Wilcoxin Rank Sum Test was computed for urine ketones before and after the experimental session. No significant differences were found pre-session ($z = .39$, $p = .35$) although a tendency for PCDS to have higher levels of urine ketones was found at post-experiment ($z = 1.29$, $p = .10$). No traces of urine ketones were found for any NDS.

Pre- and Post-Plasma Ketones

No evidence of plasma ketones was found in any experimental group at pre- or post-blood withdrawals.

CHAPTER 4
DISCUSSION AND SUMMARY

The major contribution of this study was to clarify where and how insulin-dependent diabetic and noninsulin-dependent diabetic youth differ in their physiological and metabolic responsivity to a psychological stress. Furthermore, differences between the responsiveness to the stress by the level of diabetes control was addressed. Basically the findings suggested that the insulin dependent diabetic adolescent responds similarly to psychological stress as his nondiabetic peer but generally with higher and less desirable levels of response. However, little evidence of excessive physiological responsivity or slower return to baselines accrued. This study generally replicated the directions of the findings of Hinkle and Wolf (1952) and Vandenbergh et al. (1966). However, the outcomes of this study failed to support the findings of Minuchin et al. (1978). Specifically, no group responded with a comparatively extreme increase in FFAs and slower return to baseline FFA levels. In fact, in this study the PCDS actually had a slightly lower FFA level after the stressful task compared to pre-experimentally. This does not support the notion that ketoacidosis and other serious

illness in insulin dependent diabetes are the result of an extreme physiological response to stess.

What this study has not done is to definitively tell us the reasons for the physiological and metabolic differences found between groups. Possible explanations and their merits are more fully discussed in the following sections. Likewise, the exploratory hypotheses regarding life stress and personality traits are discussed.

Reported and Observed Anxiety of Tasks

Overall there were few differences between the GCDS, PCDS, and NDS in self-reports of anxiety, task rank ordering, or observed anxiety on any of the tasks (venipuncture or speeches). The one exception, in the predicted direction, was that the PCDS tended to report a higher level of anxiety during the first speech but this tendency was lost during the second speech.

Physiological Response to Tasks

Heart rate, but not skin conductance, significantly differentiated the PCDS from the GCDS and NDS. Heart rate in PCDS was consistently about 10 BPM higher than the GCDS or NDS which were highly similar. However, no differences between groups were found for skin conductance. In fact, a tendency of higher skin conductance fluctuations in the GCDS was found compared to the PCDS and NDS. Furthermore, no evidence of heightened reactivity and slower return to

baseline emerged. Instead, a consistent pattern of higher HR level for poor control adolescents across all conditions whether rest, blood withdrawal, speech, or recovery was found.

Heart Rate

The finding of higher heart rate in the PCDS is consistent with the hypothesis that this group had higher levels of catecholamines. This hypothesis is further supported by the finding that PCDS had higher FFA, blood sugars, urine sugars, urine volume, and urine ketones. In effect, stress triggers the introduction of catecholamines and other stress hormones which set off the stress response of increased HR, FFA and blood sugar. This is the normal physiological process stimulated by stress. In the PCDS these stress responses were higher and less desirable than in the good control group or nondiabetic group. In the normal stress response insulin counters the effects of the stress hormones and operates to reduce FFA and blood sugars. By reducing the influence of the catecholamines and stress hormones insulin contributes to the recovery of heart rate to pre-stress levels. The skin conductance findings and failure to find differences between groups on self-reported and observation measures of anxiety do not support this explanation.

Other Explanations of Higher Heart Rate in PCDS

The PCDS may have more morphologic damage to circulatory organs (veins, arteries, heart) which reduces the overall efficiency and intactness of the circulatory system. One well-known risk of insulin-dependent diabetes is heart disease. The retinal damage that is a serious complication of IDDM is contributed to by vascular hemorrhages, aneurysms, and neovascularizations. To make up for the inefficiency resulting from these morphologic abnormalities/damage the heart rate may be increased to provide the blood flow required for normal body function.

Another potential explanation is that our PCDS had higher rates of autonomic neuropathy. Naliboff (1985) reports that estimates have been made that 40% of persons with diabetes have at least mild symptoms of autonomic neuropathy. He found a higher resting heart rate in a group of adult subjects with both insulin-dependent and noninsulin-dependent diabetes. Upon further examination of these individuals some evidence of autonomic neuropathy was found in almost all diabetics.

Autonomic neuropathy tends to be manifested earlier in the parasympathetic nervous system as opposed to the sympathetic nervous system. This fact may help explain the desynchrony between heart rate and skin conductance which is primarily innervated by the sympathetic nervous system. Since heart rate is heavily influenced by

parasympathetic processes as well as sympathetic processes, autonomic neuropathy may show heart rate effects before skin conductance effects. That is, a relatively greater deterioration of parasympathetic inhibition of heart rate in the PCDS would lead to an increased heart rate. If this explanation is supported, it suggests that children with insulin-dependent diabetes should be monitored for autonomic neuropathy symptoms earlier than currently is done.

Skin Conductance

The failure to find differences between experimental groups in skin conductance levels is interesting. This in conjunction with the failure to find differences between groups in self-report or observed anxiety supports the hypothesis that the groups were not differentially stressed. As a result support for an alternate explanation to increased catecholamine levels to account for the heart rate finding is suggested.

Other Explanations for Skin Conductance Findings

Skin temperature is positively associated with skin conductance response (Haroian, Lykken & Huser, 1984; Venables & Christie, 1980). If vasoconstriction or poor circulation was more pronounced in the PCDS, finger temperature would have been reduced in the PCDS. Such reductions of skin temperature in the PCDS may have acted to mask any heightened sympathetic input to the sweat

glands that are responsible for skin conductance activity. Since we did not measure vasoconstriction, finger temperature, or epinephrine, we cannot rule out this possibility.

Also, heart rate and skin conductance do not always jointly distinguish between groups although they may function similarly in both groups. For instance in our study, both skin conductance and heart rate levels increased in the plan, speech, and blood withdrawal periods and decreased in the rest and recovery periods. However, only heart rate distinguished between experimental groups. This type of finding in the literature is not unusual. Defining the mechanisms that underlie the discrepancies in physiological response systems is very difficult. For example, until recently the measurement of epinephrine was both difficult and lacked reliability. Currently, the measurement of epinephrine is improved but remains difficult and very expensive.

Skin Conductance Fluctuations

The tendency of the GCDS to have higher numbers of skin conductance fluctuations suggests that this group had a higher propensity to notice and respond to nuances in the environment whether the nuance consisted of physiograph noises, movements inside or outside the room, etc. Skin conductance level is an indication of more than anxiety. Like heart rate, skin conductance responds to new or novel

stimuli. Instead of decreasing in the orienting situation as heart rate does, skin conductance increases (Lacey, 1967). The GCDS low heart rate level, lower FFAs, lower urine volume, lower blood and urine sugars, and similar self-report, ratings, and behavioral measures of anxiety provide consistent data to rule out that this group was more anxious or aroused by the tasks. This supports the hypothesis that the GCDS are more alert to environmental changes. If so, this finding leads to the question of whether or not such a propensity might make the GCDS more alert to both internal and external changes in the environment which aid them in better decision making in the care of their diabetes. Since persons with insulin-dependent diabetes must make daily decisions directly influencing the management of their disorder such as when a snack is needed, when their insulin dose requires adjustment, or when exercise is needed, this extra awareness may benefit them.

Metabolic Reactivity

Clear metabolic differences emerged between at least one of the diabetic and the nondiabetic groups on all dependent measures. The nondiabetic group had a lower level of FFA, lower urine volume, and lower blood and urine sugars. In addition, although not always statistically significant, in every case the PCDS had the highest values

for FFA, urine volume, urine ketones and blood and urine sugars with the GCDS having the middle values.

Only minimal support for the hypothesis that PCDS would show heightened reactivity emerged. Instead, a picture of sustained higher levels of HR, FFA, and blood sugars was found. In fact, in the case of FFAs and blood sugars, the post-experimental values were reduced enough for statistical significance to be lost when it was found pre-experimentally. One possible exception to this generalization is that although no significant differences were found pre-experimentally in urine sugars and urine ketones between the GCDS and PCDS, differences were found post-experimentally with the PCDS having higher levels.

Both Hinkle and Wolf (1952) and Vandenbergh et al. (1966) found that their diabetic participants tended to have a blood glucose decrease following stress. The drop in the diabetic group tended to be higher while in the nondiabetic group the level tended to stay the same or increase slightly (as occurred in our GCDS and NDS). Both researchers point out that increased urine sugars did not help account for the blood sugar drop in the poorly controlled group. In our case, urine sugars and ketones were higher post-experimentally in the PCDS and may help explain the reduction in blood sugar and FFAs. That is, sugar and ketones were filtered from the blood into the urine. Hinkle and Wolf and Vandenbergh et al. had small

and more hetereogeneous samples which may have prevented a similar finding. It should be noted that our findings did not parallel the findings of Minuchin et al. (1978). Whereas the PCDS FFA level post-experimentally was lower than pre-experimentally and the NDS and GCDS slightly higher, the psychosomatic diabetic group in the Minuchin et al. study showed higher FFA levels post-experimentally and the other diabetic and nondiabetic groups lower FFA levels.

Another explanation of the decreased final blood sugar and FFA level in our sample is that the PCDS had a higher metabolic need for energy to sustain normal body functions. The increased HR across tasks provides support for this notion. That is, the body must burn more energy (FFA, blood sugar) to deal with a higher heart rate.

Life Stress and Diabetes Control

The hypothesis that number of reported life stress events would be related to level of diabetes control was not confirmed. No relationship between diabetes control, determined in this study by Hemoglobin A1 value, and amount of positive, negative, or combined positive and negative life events was found. Likewise no differences emerged between the diabetic and nondiabetic groups. The failure to find differences between groups on the LEC suggests that it is not the amount of reported life stress per se that influences level of diabetes control. This conclusion is supported further by the lack of reported differences

between groups in stressfulness of blood withdrawal and speech giving even though physiological responses differed between groups.

Brand, Johnson and Johnson (1983) report a finding similar to that of this study. They found no relationship between Hemoglobin A1 and the LEC in diabetic youth aged 10 to 17.8 years attending a summer camp. The only correlation that they found which approached significance was between negative life change and urine ketones.

In the two studies that found a relationship between diabetes health variables, in particular Hemoglobin A1, and reported life stress, several differences emerge. Bradley's (1979) study differed from ours in several ways. First, she included British adult subjects with insulin-dependent diabetes and adult onset diabetes. Secondly, she used another life events change instrument than the LEC. Chase and Jackson (1981) also used another life stress questionnaire and measured life stress over the preceding 3 months instead of year as in the current study. As in this study, they looked at adolescents with insulin-dependent diabetes. They found a high correlation between amount of reported life stress and Hemoglobin A1 values ($r = .41$). In contrast, the current study found a nonsignificant Pearson correlation between negative life events and Hemoglobin A1 of .16 and total life events of .02. The participants in this study were matched for

duration of diabetes, sex, age, and race while those in Chase and Jackson's were not. It was also confirmed from both parents and adolescent that the prescribed insulin dosage was administered at the same time generally and specifically the night before and morning of the experiment. As a result the sample was different.

Perhaps an instrument more sensitive to everyday stresses would show a stronger relationship. Kanner, Coyne, Schaefer and Lazarus (1981) suggest that a life stress scale designed to measure smaller, more frequent daily stressors might yield better results in predicting psychological and health outcomes than the major life event scales such as the LEC. Such scales are now available.

Although more refined techniques to assess stress might yield higher predictive power, other factors need assessment to account for significant amounts of the variance. For instance, in our study we found for the most part that the experimental groups reported and behaved in ways suggesting that they viewed the tasks with similar levels of stress/anxiety. Yet the PCDS were in much poorer control of their disorder and physiologically dealt less efficiently and effectively with the stresses. It is reasonable to expect that the physiological predispositions/states, behavioral tendencies, as well as cognitive traits of the individual, must be considered to

make the best predictions of the effect of stress on health.

Personality Findings

On the JEPQ/EPQ the GCDS were less neurotic than both other groups and more conventional than the NDS. This finding is similar to Simonds (1977) who found (using parental reports) that the poorly controlled group was more likely to be anxious and depressed, the same terms Eysenck uses to describe an introverted neurotic personality. Likewise Simonds reported that his good control group reported fewer conflicts than the nondiabetic group and had an unusually low incidence of parental divorce. Our findings in addition to Simonds suggest that adolescents with insulin-dependent diabetes in good control may be unusually well-adjusted and conventional or socially rule oriented. Also in accord with Simonds, they suggest that in general poorly controlled diabetic adolescents have average or normal psychological adjustment.

No evidence emerged supporting differential physiological or metabolic responsiveness due to neuroticism. This suggests that neuroticism is not related to poor control through a clearly identifiable physiological or metabolic mechanism. (See Appendix J for the correlation coefficients between neuroticism and physiological and metabolic variables.) It appears more reasonable to postulate that the more conventional,

socially appropriate self-report response tendencies of the GCDS may be related to behavioral tendencies to follow prescribed instructions and advice regarding care. This may reach into the general living style of the respondent. She may be more inclined to eat properly, exercise as directed, and avoid less healthful life styles.

Future Research

Several lines of research are suggested by the present findings. The finding of desynchrony of heart rate and skin conductance levels raises several questions. One is whether the differences between PCDS and GCDS were due to different levels of catecholamine response. Measurement of plasma catecholamine would help answer this question. If the PCDS had higher levels of catecholamine, that group would be more physiologically stressed. If no differences in catecholamines were found, our skin conductance findings would be expected. We would not have to consider other explanations of why no skin conductance differences emerged, e.g., increased circulatory damage and/or autonomic neuropathy.

Another research question relates to the presence of increased circulatory system damage or autonomic damage. Several avenues of research are available to explore these hypotheses including medical examination and tests to assess circulatory and autonomic neuropathy damage. However, whether or not increased damage is identified, we

still may not know the degree to which the damage contributes to our findings of increased heart rate.

Another approach to this question is to see if the increased heart rate and metabolic responses can be reversed. That is, can a poor control diabetic group be treated by some method and as a result respond physiologically and metabolically like the good control group. To the extent that circulatory or autonomic neuropathy is resistant to intervention, reversal of heart rate findings would not be expected.

Another line of investigation relates to the question of whether or not the PCDS is more stress sensitive but, due to their initial high level of being stressed, differential rates of response were lost. More stress sensitive persons might become more physiologically aroused about participating in the experiment and their heightened initial arousal may not be generalizable to other situations. Measurement of heart rate and some metabolic measures (perhaps FFA and urine volume) in ordinary and nonintrusive ways would be very informative. Heart monitoring devices could be attached and worn over time so that the participant "forgets" about the device. Blood sample would be more difficult to accomplish. However, as metabolic measures such as glycosolated hemoglobin become available, indicants of the metabolic state over time will help address this question.

Several other questions were raised by the findings. One was whether or not the GCDS were more sensitive to novel or changing stimuli in the environment as was suggested by their increased skin conductance fluctuations. Likewise, are they more aware of internal states and changes in the body. As suggested by Simonds (1977) and our personality findings, are the GCDS more psychologically well-adjusted compared to both their diabetic and nondiabetic peers? Furthermore, are they more rule-oriented and likely to follow medical advice and live more health-oriented life styles?

Implications

This study has several practical implications. First, the high heart rate in the PCDS may be indicative of serious medical problems in this group that to date have not been expected to be manifested at so young an age. Generally, adolescents of this age group are not closely monitored for symptoms of autonomic neuropathy or circulatory disease. These findings suggest that regular monitoring should be taking place for these youngsters.

A second implication is that the PCDS do not build up excessive FFAs or blood sugars in response to a stress but return to their pre-stress baseline as their GCDS and NDS counterparts. This does not provide support for a "psychosomatic" hypothesis, for example as suggested by Minuchin et al. (1978), in which predisposed

insulin-dependent diabetic youngsters become sick when exposed to a stress (for Minuchin et al., the family stress of a "psychosomatic family").

A final implication is that the GCDS are more psychologically healthy and may be behaviorally oriented toward better caretaking of their disease. This requires much more investigation and can only be hypothesized about at this time. It fits nicely with the current finding of other researchers (Simonds, 1977).

APPENDIX A
SPEECH TOPIC

Speech Topic 1

Hello. Your speech will be on the topic of "a recent fun or pleasant time I had or something very nice that happened to me." You are free to pick any event or angle you wish. Some ideas include a grade you especially like; a good time with your friend, parent, brother, sister, etc.; special equipment that you got like a bike or record player; an event you got to go to, etc. You can talk about when it occurred, how it came about, what it was like for you, how you still feel, what happened later, etc.

Speech Topic 2

Hello. Your speech will be on the topic of "the last big argument I had or my most recent big disappointment." You are free to pick any event or angle you wish. Some ideas include a grade you did not like; an argument with your friend, parent, brother, sister, etc.; equipment that broke like a bike or record player; an event you had to miss, etc. You can talk about when it occurred, how it came about, what it was like for you, how you still feel, what happened later, etc.

APPENDIX B
HEART FUNCTIONING

The heart in humans and higher mammals is a complexly innervated organ whose activity frequently is used as an indicator of a psychological process. Heart rate (HR) acceleration and deceleration in response to various stimuli have long been noted by psychologists. Heart rate decelerates in response to simple stimuli and accelerates to intense or threatening stimuli, during periods of word association, and during mental arithmetic. Sokolov referred to a HR increase in response to a stimulus as a defense response whereas HR deceleration was called an orienting response. Lacey (Siddle & Turpin, 1980) hypothesized that this 'directional fractionation' could be explained by the nature of the stimuli. Stimuli requiring environmental intake and consequent sensory integration would lead to HR deceleration. Lacey further suggested that the HR deceleration was due to an indirect effect of HR on cortical activity. Another explanation that has been offered is that lowered body activity in general facilitates sensory intake by reducing distraction. The second part of the 'directional fractionation' is that HR accelerates in response to stimuli requiring spurring

environmental rejection. Obrist (1976) introduces a new principle in HR activity. He uses the term cardiac-somatic coupling to describe the principle that HR changes in accordance with somatic need. In other words, as somatic activity increases HR increases and as somatic activity decreases HR decreases. However, Obrist points out that cardiac-somatic coupling breaks down in those situations related to active avoidance of aversive stimuli. These situations result in substantial HR increase that is unrelated to somatic activity.

The heart is neurally innervated by two interactive inputs from the sympathetic and parasympathetic branches of the autonomic nervous system (ANS). The sympathetic input consists of adrenergic fibers originating in the spinal cord via the stellate and caudal cervicle ganglia. The neural transmitter substances are epinephrine and norepinephrine. Excitation of these fibers increases HR and blood pressure and is associated with myocardiac contractile force. Parasympathetic fibers (cholinergic) emanate from the vagus nerve. Excitation of these fibers reduces HR and contractile force and, in general, is antagonistic (opposite in effect) to sympathetic excitation. In general, the higher the sympathetic input, the higher the parasympathetic input. Heart activity influences baroreceptors in the vagal nerve which respond according to the level of heart activity by either

inhibiting HR when HR is high and reducing parasympathetic inhibition when HR is low.

APPENDIX C
BRIEF NOTE ON SKIN CONDUCTANCE

The eccrine sweat glands are of particular importance to the psychophysiologist and are sympathetically innervated. These glands appear to play a role in thermal regulation only for very hot temperatures. Eccrine sweat glands are widespread over the body but are particuarly dense on the palmar and plantar surfaces. Martin and Venables (1980, p. 10) point out that it is realistic to think of the principle effector mechanism in SC measurement as sweat glands arranged as resistors in parallel. The eccrine sweating produces SC changes which are related to orienting or signal responses. At the skin surface sweat is both discharged and reabsorbed.

APPENDIX D
VENIPUNCTURE QUESTIONNAIRE

Please rate how bothered you are in general by having blood drawn.

1	2	3	4	5
extremely bothered		moderately bothered		not bothered at all

Please rate how painful the venipuncture procedure was for you.

1	2	3	4	5
extremely painful		moderately painful		not painful at all

APPENDIX E
VENIPUNCTURE OBSERVATION CHECKLIST

Subject Name _____ Number _____
Rater Name _____ Rating Date _____

BEHAVIOR	TIME PERIOD 1	2	3	4	5	6	SUM
Time:	*	*	*	*	*	*	
Verbalized Pain	*	*	*	*	*	*	
Verbalized Anxiety	*	*	*	*	*	*	
Verbal Delay	*	*	*	*	*	*	
Looks Away	*	*	*	*	*	*	
Facial Grimaces	*	*	*	*	*	*	
Moisten Lips	*	*	*	*	*	*	
Swallow	*	*	*	*	*	*	
Heavy Breathing	*	*	*	*	*	*	
Smile Miserable	*	*	*	*	*	*	
Tearing/Crying	*	*	*	*	*	*	
Behavioral Delay	*	*	*	*	*	*	
Facial Emblem Negative	*	*	*	*	*	*	
*Facial Emblem Neutral	*	*	*	*	*	*	
*Smile False	*	*	*	*	*	*	
*Smile Spontaneous	*	*	*	*	*	*	
*Laughs	*	*	*	*	*	*	
*Talks Other	*	*	*	*	*	*	
*Blink Number	*	*	*	*	*	*	

	None				Moderate					Extreme
*Anxiety General	0	1	2	3	4	5	6	7	8	9
*Activity General	0	1	2	3	4	5	6	7	8	9
*Positive General	0	1	2	3	4	5	6	7	8	9

* not scored or analyzed

APPENDIX F
MANUAL FOR SCORING VENIPUNCTURE OBSERVATION CHECKLIST AND TIMED BEHAVIOR CHECKLIST-MODIFIED FORM

General Procedure

Both the Venipuncture Observation Checklist (VOC) and the Timed Behavior Checklist-Modified Form (TBCL-M) have similar formats for scoring. First of all the videotapes are readied for display on the Betamax videorecorder set. The viewer(s) arrange themselves in comfortable seats placed in a position maximizing their view of the tapes. If two or more viewers are present, each is situated so that no one can observe another scoring. This is done to prevent inflation of the reliability measures by influences other than the videotapes. Each scorer should have a clipboard, pen or pencil, and scoring sheet. Before viewing the videotape, scoring sheets should be completed for subject's name or initials, ID number, scorer's name, date, and whether the scorer is a reliablity checker. On the TBCL-M the speech number should be recorded (either 1 or 2) depending on whether the first or second speech is being scored. The time settings delineating each 20 second period should be filled in at the top of the form. The initial time setting is obtained from the videorecorder

clock and subsequent times figured by adding 20 seconds to the preceding time period.

Scoring Forms

Both forms have similar layouts. Each has a list of specific behaviors going down the left hand column. To the right of the list of behaviors, time period columns appear with a separate box for each specific behavior. Each time period accounts for 20 seconds for behavior.

Scoring

Scoring consists of checking behaviors that appear during each time segment. Behaviors are scored for their presence or absence. If a behavior occurs during a time segment, the corresponding box is checked. If it does not occur, a zero is placed in the corresponding box. For both forms (VOC, TBCL-M) the videotape is viewed for 20 seconds. The videotape is stopped by pressing the stop button. The scorer then marks the appropriate box for the behavior(s) that occurred during that 20 second period. Each segment will require viewing several times to maximize adequate scoring.

Venipuncture Observation Checklist

Two minutes of the venipuncture procedure will be scored. This accounts for six time periods. The 60 seconds immediately before and after the needle insertion will be scored. If needle insertion occurs before 60

seconds has lapsed continue to score after needle insertion until six time periods have been scored.

Definitions and Descriptions of Behavioral Categories

Verbalized pain: says hurts, painful, ouch, ohhh, or other verbal indication of pain/discomfort.

Verbalized anxiety: says scary, afraid, anxious, doesn't like, or asked if it will hurt; exclude painful.

Verbal delay: makes excuses to delay venipuncture; example includes asking phlebotomist to "wait a second."

Looks away at time of injection: this is scored only at the time of needle insertion.

Facial grimaces: includes noncommunicative facial movements such as tics and other uncoordinated muscle movements; includes involuntary flinches.

Moistens or bites lips: licks or bites lips.

Swallows: swallows (note closed mouth and throat movement).

Heavy and/or uneven breathing: involves obvious and clear heavy and/or uneven breathing; include heavy and uneven breathing associated with crying.

Smile miserable: involves a smile combined with clear negative affect; usually a smile with a contracted upper lip and may involve other facial expressions indicative of negative affect; it is differentiated from facial emblem negative by the smile which is absent in the facial emblem negative.

Tearing/crying: tearing or crying; noticable welling or tears in the eyes is scored.

Behavioral delay: involves a behavioral gesture that delays venipuncture; examples include withdrawal of arm, failure to extend arm when appropriate, or covering site of injection.

Facial emblem negative: involves the coordinated tensing and movement of facial muscles to provide a facial expression that communicates negative affect to the viewer; exclude if a smile is present; example includes a snarled upper lip and nose or gritted teeth with forehead frown.

The Time Behavior Checklist-Modified Form

The TBCL-M is scored in the same manner as the VOC except that there are nine 20 second periods to be scored. Many of the categories of behavior are the same and the same definitions and descriptions apply in both scales. Both include the following behavioral categories: facial grimaces, moistens or bites lips, swallows, smile miserable, heavy or uneven breathing, and facial emblem negative. The distinct categories for the TBCL-M are as follows:

No eye contact: fewer than three contacts with total duration of all contacts less than two seconds.

Face deadpan: face looks bland, emotionless, flat for entire 20 second period; associated with minimal eye and head movement.

Vocal quivering: voice noticably quivers, breaks, or has obvious pitch changes; includes noticable speech flow or rhythm changes.

Speech blocks: includes evidence of speech blocks where speaker cannot continue; examples include asking researcher how much time left to speak, 3 seconds of silence, having to repeat speech, saying have run out of things to say.

Stammer/stutter: includes stammering or stuttering in which at least two unnecessary sounds occur consecutively; examples include "a a" or "f-f-friend"; excludes insertion of unnecessary words such as "you know," unless phrase is repeated twice consecutively; score if 5 or more breaks in flow occur in the 20 second period.

APPENDIX G
RANK ORDER OF TASK FORM

Please rank the three tasks according to how stressful/anxious each one was for you. Place a 1 beside the most stressful task for you and a 3 beside the least stressful task. Place a 2 beside the task that fell between these tasks in stressfulness for you.

Speaking on a recent pleasant time _____

Speaking on a recent argument or disappointment _____

The venipuncture procedure _____

APPENDIX H
TIMED BEHAVIOR CHECKLIST-MODIFIED FORM

Subject Name _____ Number _____
Rater Name _____ Rating Date _____ Speech # _____

BEHAVIOR	TIME PERIOD									
	1	2	3	4	5	6	7	8	9	SUM
Time:	*	*	*	*	*	*	*	*	*	
No Eye Contact	*	*	*	*	*	*	*	*	*	
Facial Grimaces	*	*	*	*	*	*	*	*	*	
Face Deadpan	*	*	*	*	*	*	*	*	*	
Moisten Lips	*	*	*	*	*	*	*	*	*	
Swallows	*	*	*	*	*	*	*	*	*	
Smile Miserable	*	*	*	*	*	*	*	*	*	
Vocal Quivering	*	*	*	*	*	*	*	*	*	
Speech Blocks	*	*	*	*	*	*	*	*	*	
Stammer/Stutter	*	*	*	*	*	*	*	*	*	
Heavy Breathing	*	*	*	*	*	*	*	*	*	
Facial Emblem Neg.	*	*	*	*	*	*	*	*	*	
*Facial Emblem Neut.	*	*	*	*	*	*	*	*	*	
*Smile False	*	*	*	*	*	*	*	*	*	
*Smile Spontaneous	*	*	*	*	*	*	*	*	*	
*Laughs	*	*	*	*	*	*	*	*	*	
*Blink Number	*	*	*	*	*	*	*	*	*	

	None				Moderate					Extreme
*Anxiety General	0	1	2	3	4	5	6	7	8	9
*Activity General	0	1	2	3	4	5	6	7	8	9
*Positive General	0	1	2	3	4	5	6	7	8	9

* not scored or analyzed

APPENDIX I
PEARSON CORRELATIONS FOR SELECTED MEASURES IN VENIPUNCTURE, SPEECH I AND SPEECH II CONTROLLING FOR SEX (PARTIALLED OUT)

SPEECH I:

	STAIC 2	PRCS	Extraversion	Neuroticism	Conventionality	LEC	TBCL-Modified	Post Blood Sugar	Post Urine Volume	Post FFA	Rest HR	Speech HR	Rest SC
Self-Reported Measures													
STAIC 2	1.0												
PRCS	.49*	1.0											
JEPQ													
Extraversion	-.29*	-.09	1.0										
Neuroticism	.55*	.50*	-.13	1.0									
Conventionality	-.06	-.13	.10	-.19	1.0								
LEC	.19	.27*	-.08	.36*	.01	1.0							
Observed Measures													
TBCL-Modified for Speech I	.21	.14	-.34*	.004	-.02	-.06	1.0						
Metabolic-Physiological Measures													
Post Blood Sugar	.11	.12	-.09	-.17	.19	.01	.07	1.0					
Post Urine Volume	-.02	-.07	.08	-.13	.24*	-.08	-.10	.72*	1.0				
Post FFA	.20	.14	-.19	.12	.13	-.004	-.00	.33*	.32*	1.0			
Rest HR	.11	-.17	-.07	-.10	-.01	-.31*	.07	.39*	.32*	.28*	1.0		
Speech I HR	.01	-.19	-.04	-.08	-.02	-.37*	-.13	.30*	.23	.27*	.90*	1.0	
Rest SC	-.11	-.14	-.13	-.19	.03	-.27*	-.03	.12	.16	.19	.28*	.22	1.0
Speech I SC	-.12	-.14	-.06	-.15	.10	-.22	-.11	.13	.20	.21	.26*	.22	.94*

* Significant at the .05 level.

SPEECH II:

	STAIC 3	PRCS	Extraversion	Neuroticism	Conventionality	LEC	TBCL-Modified	Post Blood Sugar	Post Urine Volume	Post FFA	Rest HR	Speech II HR	Rest SC
Self-Report Measures													
STAIC 3	1.0												
PRCS	.43*	1.0											
JEPQ													
Extraversion	-.04	-.09	1.0										
Neuroticism	.18	.50*	-.13	1.0									
Conventionality	.03	-.13	.10	-.19	1.0								
LEC	.05	.27*	-.08	.36*	.01	1.0							
Observed Measures													
TBCL-Modified for Speech II	.12	.11	-.27*	.12	-.26	-.02	1.0						
Metabolic-Physiological Measures													
Post Blood Sugar	-.06	-.12	-.09	-.17	.19	.01	-.06	1.0					
Post Urine Volume	-.00	-.07	.08	-.13	.24*	-.08	-.06	.72*	1.0				
Post FFA	-.02	.14	-.19	.12	.13	-.004	-.21	.33*	.32*	1.0			
Rest HR	-.14	-.18	-.08	-.10	.03	-.31*	-.12	.37*	.30*	.31*	1.0		
Speech II HR	-.07	-.19	-.09	-.10	-.04	-.25*	.04	.33*	.30*	.38*	.89*	1.0	
Rest SC	.02	-.12	-.11	-.14	.04	-.22	-.22	.04	.07	.19	.20	.12	1.0
Speech II SC	.16	-.16	-.13	-.04	.14	-.20	-.15	.15	.18	.24	.23	.16	.84*

* Significant at the .05 level.

VENIPUNCTURE:

	STAIC 1	VQ, Item I	VQ, Item II	Extraversion	Neuroticism	Conventionality	LEC	VOS	Post Blood Sugar	Post Urine Volume	Post FFA	Rest HR	Blood Withdrawal HR	Rest SC
Self-Reported Measure														
STAIC	1.0*													
VQ														
Item I: fear**	-.59*	1.0*												
Item II: pain**	-.44*	.37*	1.0											
JEPQ														
Extraversion	-.28*	.23	.28*	1.0										
Neuroticism	.44*	.25*	-.32*	-.13	1.0									
Conventionality	-.22	.26*	.17	.10	-.19	1.0								
LEC	-.02	-.06	-.22	.08	.36*	.01	1.0							
Observed Measure														
VOS	.14	-.14	-.52*	-.32*	.29*	.21	.37*	1.0						
Metabolic Physiological Measure														
Post Blood Sugar	.13	-.004	-.14	-.09	-.17	.19	.01	.48*	1.0					
Post Urine Volume	.10	-.09	-.13	.08	-.13	.24*	-.08	.16	.72*	1.0				
Post FFA	.25	-.24	-.09	-.19	.12	.13	-.004	.06	.33*	.32*	1.0			
Rest HR	.23	-.19	.07	.02	-.05	-.003	-.30*	-.11	.33*	.23	.23	1.0		
Blood Withdrawal HR	.39*	-.33*	-.11	-.12	.04	-.06	-.14	.20	-.39*	.27*	.36*	.85*	1.0	
Rest SC	.28*	-.25*	-.13	-.14	-.11	-.08	-.30*	-.14	.18	.10	.23	.22	.15	1.0
Blood Withdrawal SC	.32*	-.37*	-.16	-.07	-.17	-.04	-.22	-.07	.28*	.35*	.22	.28*	.21	.85*

* Significant at the .05 level.

** Note: for the VQ, both items I and II were scored in the direction of the lower the score, the higher the fear or pain reported.

APPENDIX J
PEARSON PRODUCT MOMENT CORRELATIONS
CONTROLLING FOR SEX BETWEEN EXTRAVERSION
AND NEUROTICISM AND PHYSIOLOGICAL VARIABLES

Physiological Variables	Extraversion		Neuroticism	
Post Blood Sugar	.09	(S=.31)	-.17	(S=.17)
Post Urine Volume	.08	(S=.30)	-.13	(S=.20)
Post FFA	-.19	(S=.12)	.12	(S=.23)
Task Venipuncture				
Hr	-.12	(S=.22)	.04	(S=.40)
SC	-.07	(S=.31)	-.17	(S=.13)
HR Change	-.26	(S=.04)	.16	(S=.15)
SC Change	.07	(S=.33)	.17	(S=.13)
Task Speech I				
HR	.04	(S=.39)	-.09	(S=.28)
SC	.06	(S=.35)	-.15	(S=.6)
HR Change	.26	(S=.04)	.04	(S=.39)
SC Change	.20	(S=.10)	1.0	(S=.25)

BIBLIOGRAPHY

Akerstedt, T., & Theorell, T. (1976). Exposure to night work serum gastrin reaction, psychosomatic complaints personality variables. Journal of Psychosomatic Research, 20, 479-484.

Baker, L., Barcai, A., Kay, R., & Hague, N. (1969). Beta adrenergic blockade and juvenile diabetes. Journal of Pediatrics, 75, 19-29.

Bedell, J., & Roitzch, J. (1976). The effects of stress on state and trait anxiety in emotionally disturbed, normal, and delinquent children. Journal of Abnormal Child Psychology, 4, 173-177.

Borkovec, T., & O'Brien, G. (1977). Relation of autonomic perception and its manipulation to the maintenance and reduction of fear. Journal of Abnormal Psychology, 86, 163-171.

Bradley, C. (1979). Life events and the control of diabetes mellitus. Journal of Psychosomatic Research, 23, 159-162.

Brand, A., Johnson, J., & Johnson, S. (1983). Life stress and diabetic control in children and adolescents with insulin-dependent diabetes. Unpublished manuscript.

Cahill, G., Etzwiler, D., & Freinkel, N. (1976). Control and diabetes. New England Journal of Medicine, 294, 1004.

Chase, H., & Jackson, G. (1981). Stress and sugar control in children with insulin-dependent diabetes mellitus. Brief Clinical and Laboratory Observations, 6, 1011-1013.

Ciminero, R., Calhoun, K., & Adams, H. (1977). Handbook of behavioral assessment. New York: John Wiley and Sons.

Denny, D., & Frisch, M. (1981). The role of neuroticism in relation to life stress and illness. Journal of Psychosomatic Research, 25, 303-307.

Ekman, P., & Friesen, W. (1975). Unmasking the face: A guide to recognizing emotions from facial clues. Princeton, New Jersey: Prentice Hall.

Ekman, P., & Friesen, W. (1982). Felt, false, and miserable smiles. Journal of Nonverbal Behavior, 6(4), 238-251.

Eysenck, H. (1967). The biological basis of personality. Springfield, IL: Charles C. Thomas.

Eysenck, H., & Eysenck, S. (1975). Manual: Eysenck Personality Questionnaire. San Diego: Educational and Industrial Testing Service.

Eysenck, H., & Eysenck, S. (1978). Manual of the Eysenck Personality Questionnaire: Junior and adult. San Diego: Education and Industrial Testing Services.

Fallstrom, K. (1974). On the personality structure in diabetic school children. Acta Paediatrica, 254, 5-71.

Finch, A., Kendall, P., Montgomery, L., & Morris, T. (1975). Effects of two types failure on anxiety. Journal of Abnormal Psychology, 84, 583-585.

Finch, A., Montgomery, L., & Deardorff, P. (1974). Reliability of state-trait anxiety with emotionally disturbed children. Journal of Abnormal Child Psychology, 2, 67-69.

Gad, M., & Johnson, J. (1980). Correlates of adolescent life stress as related to race, SES, and levels of perceived social support. Journal of Clinical Child Psychology, 9, 13-16.

Ganong, W. (1971). Review of medical physiology (6th ed.). Los Angeles: Lange Medical Publications.

Gilbert, B., & Johnson, S. (1982). Effects of a peer-modeling film in anxiety-reduction and skill acquisition in children learning self-injection of insulin. Behavior Therapy, 13, 186-193.

Gray, J. (1975). Elements of a two-process of learning. London: Academic Press.

Harkavy, J. (1981). A study of the relationship of knowledge, behavior, and control in juvenile diabetes. Unpublished master's thesis, University of Florida, Gainesville, Florida.

Haroian, K., Lykken, D., & Huser, R. (1984). SPR Abstracts: The effect of hand temperature on electrodermal measurement. Psychophysiology, 21(5), 580.

Harvey, F., & Hirschmann, R. (1980). The influence of extraversion and neuroticism on heart rate responses to aversive visual stimuli. Personality and Individual Differences, 1, 97-100.

Hinkle, L., & Wolf, S. (1952). Importance of life stress in course and management of diabetes mellitus. Journal of American Medical Association, 148, 513-525.

Johnson, J., & McCutcheon, S. (1980). Assessing life stress in older children and adolescents: Preliminary findings with the life events checklist. In I. Sarason & C. Spielberger (Eds.), Stress and anxiety (Vol. 7, pp. 111-126). Washington, DC: Hemisphere.

Johnson, J., & Sarason, I. (1982). Life stress research: Where we have been--where we are going. Unpublished manuscript.

Johnson, S. (1980). Psychosocial factors in juvenile diabetes: A review. Journal of Behavioral Medicine, 3, 95-116.

Kanner, A., Coyne, J., Schaefer, C., & Lazarus, R. (1981). Comparison of two modes of stress measurement daily hassles and uplifts versus major life events. Journal of Behavioral Medicine, 4, 1-39.

Knight, M., & Borden, R. (1979). Autonomic and affective reactions of high and low socially-anxious individuals awaiting public performance. Psychophysiology, 16, 209-213.

Koski, M., & Kumento, A. (1975). Adolescent development and behavior: A psychosomatic followup study of childhood diabetes. In Z. Laron (Ed.), Diabetes in juveniles: Medical and rehabilitation aspects. Modern problems in paediatrics (Vol. 12, pp. 348-353). Basel: Karger.

Lacey, J. (1967). Somatic response patterning and stress: Some revisions of activation theory. In M. H. Appley & R. Trumbull (Eds.), Psychological stress: Issues in research (pp. 14-36). New York: Appleton-Century-Crofts.

Levenson, R., Jaffee, L., & McFall, R. (1978, April). Heightened responsibility to stress in nonassertive, low self-confident subjects. Presented at Society of Psychophysiological Research, Vancouver, BC.

Martin, I., & Venables, P. (1980). Techniques in psychophysiology. New York: John Wiley and Sons.

Mehrabian, A., & Ross, M. (1977). Quality of life change and individual differences in stimulus screening in relation to incidence of illness. Psychological Reports, 41, 267-278.

Minuchin, S., Rosman, B., & Baker, L. (1978). Psychosomatic families. Cambridge, MA: Harvard University Press.

Naliboff, B. (1985). Biobehavioral studies of stress and stress management in diabetes. Unpublished manuscript.

Obrist, P. (1976). The cardiovascular behavioral interaction--as it appears today. Psychophysiology, 3, 95-107.

Paul, G. (1966). Insight vs. desensitization in psychotherapy. Palo Alto, CA: Stanford University Press.

Pinter, E., Peterfy, G., Cleghorn, J., & Pattee, C. (1967). The influence of emotional stress on fat mobilization: The role of endogenous catecholamines and B adrenergic receptors. American Journal of Medical Science, 254, 634-651.

Shipman, W., Heath, H., & Oken, D. (1979). Response specificity among muscular and autonomic variables. Archives of General Psychiatry, 23, 369-374.

Siddle, D., & Turpin, G. (1980). Measurement, quantification, and analysis of cardiac activity. In I. Martin & P. Venables (Eds.), Techniques in psychotherapy (pp. 139-246). New York: John Wiley and Sons.

Simonds, J. (1977). Psychiatric status of diabetic youth matched with a control group. Diabetes, 26, 921-925.

Stelmack, R. (1981). The psychophysiology of extraversion and neuroticism. In H. Eysenck (Ed.), A model for personality. New York: Springer-Verlag.

Tarnow, J., & Silverman, S. (1981-82). The psychophysiologic aspects of stress in juvenile diabetes. International Journal of Psychiatry in Medicine, 11, 25-44.

Vandenbergh, R., Sussman, K., & Titus, C. (1966). Effects of hypnotically induced acute emotional stress on carbohydrate and lipid metabolism in patients with diabetes mellitus. Stress and Metabolism in Diabetes, 28, 382-389.

Venables, P., & Christie, M. (1980). Electrodermal activity. In I. Martin & P. Venables (Eds.), Techniques of psychophysiology (pp. 3-62). New York: John Wiley and Sons.

BIOGRAPHICAL SKETCH

Brenda Gilbert was born in Knoxville, Tennessee, in January of 1947. She obtained her M.S.W. degree from Florida State University in 1972 and worked 5 years as a social worker. She returned to the University of Florida and earned an M.A. and Ph.D. in clinical psychology. Her research interests are in the areas of medical psychology and her focus has been on coping with chronic illness in children and adolescents. She is married and the mother of two beautiful girls. Currently, she is the coordinator of an adolescent inpatient program.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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